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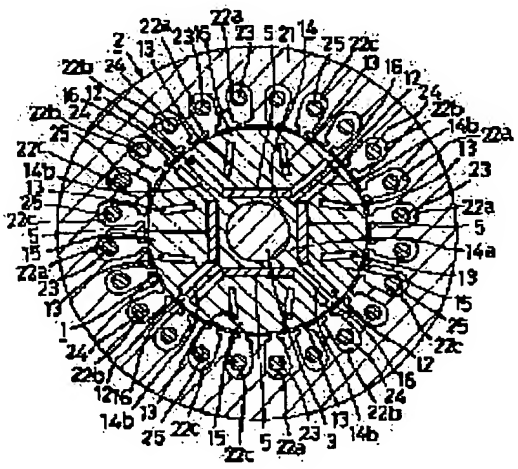
(54) PERMANENT MAGNET MOTOR

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance the driving efficiency when a rotor is rotated, by housing the rotor provided with permanent magnets in the space formed in the central part of a stator in such a manner that the rotor is rotatable, and sequentially energizing windings in a plurality of phases placed so that the rotor is encircled with the windings.
SOLUTION: A plurality of circumferential iron cores 15 are installed in contact with the surfaces of permanent magnets 5 on the stator 2 side. A pair of through holes 13, 13 penetrating each of the circumferential iron cores 15 in the direction of the axis of a rotor 1, are formed in the areas between the permanent magnets 5 and the stator 2 on each of the circumferential iron cores 15. The pairs of the through holes 13, 13 are symmetrically positioned on both the sides of the magnetic center of magnetic lines of force generated between the permanent magnets 5 and the stator 2. Each of the through holes 13, 13 is in slit shape, and they are arranged in dogleg shape with the intervals between them getting narrower as they go toward the stator 2.



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CLAIMS

[Claim(s)]
[Claim 1] The permanent magnet motor by which the low permeability section for converging the line of magnetic force generated between a permanent magnet (5) and a stator (2) on the center section of the periphery section iron core (15) is formed in the periphery section iron core (15) in the permanent magnet motor by which the periphery section iron core (15) was arranged in the stator (2) side of a permanent magnet (5) while the permanent magnet (5) was arranged by the rotator (1).
[Claim 2] A rotator (1) is held in the space formed in the center section of a stator (2) pivotable, and it is constituted. To a stator (2) While the revolving shaft of a rotator (1) and the coil of two or more phases extended to parallel are arranged in two or more locations which surround a rotator (1), to a rotator (1) While two or more permanent magnets (5) magnetized in the direction of a path which intersects perpendicularly with a revolving shaft are arranged in two or more locations which surround a revolving shaft By making the front face by the side of the stator (2) of each permanent magnet (5) contact, arranging two or more periphery section iron cores (15), and carrying out sequential energization at the coil of said two or more phases In the permanent magnet motor made to rotate a rotator (1) to each periphery section iron core (15) The permanent magnet motor by which the low permeability section for converging the line of magnetic force generated between each permanent magnet (5) and a stator (2) on the center section of the periphery section iron core (15) is formed in the field inserted into each permanent magnet (5) and a stator (2).
[Claim 3] It is the permanent magnet motor according to claim 1 or 2 by which the low permeability section consists of a through tube (13) of the pair established by penetrating each periphery section iron core (15) to the shaft orientations of a rotator (1), and (13), and the through tube (13) of this pair and (13) are arranged at both sides on both sides of the magnetic center line of the line of magnetic force generated between each permanent magnet (5) and a stator (2).
[Claim 4] For the revolving shaft of a rotator (1), the through tube (13) of said pair and (13) are a permanent magnet motor according to claim 3 by which mutual spacing is narrow toward the stator (2) in the cross section which intersects perpendicularly while each has a long and slender slit configuration.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the coil of two or more phases which held the rotator equipped with the permanent magnet in the space formed in the center section of a stator pivotable, surrounded the rotator, and were arranged by carrying out sequential energization at the permanent magnet motor made to rotate a rotator.
[0002]
[Description of the Prior Art] Drawing 5 expresses the structure of the conventional permanent magnet motor, and the cylinder-like rotator (10) is held in the space formed in the center section of a cylinder-like stator (2) pivotable. A stator (2) is equipped with a ring-like stator iron core (21), a rotator (10) is surrounded to the inner skin of this stator iron core (21), and 24 slots (22a) (22b) (22c) penetrated to the shaft orientations of a rotator (10) are cut in it at equal intervals. Specifically, repeat grooving of U phase slot (22a), V phase slot (22b), and the W phase slot (22c) is carried out at a time at two counterclockwise rotations. And U phase winding (23), V phase winding (24), and W phase winding (25) are twisted around U phase slot (22a), V phase slot (22b), and W phase slot (22c), respectively.
[0003] On the other hand, the rotator (10) has the center-section iron core (14) with which a cross-section configuration consists of a square shank (14a) and the four arm sections (14b) (14b) (14b) (14b) extended toward a stator (2) from four corners of this shank (14a). In addition, a center-section iron core (14) carries out several multi-sheet laminating of the sheet metal-like piece of iron, and is formed. The output shaft (3) is being penetrated and fixed to the core of the shank (14a) of a center-section iron core (14). Moreover, an output shaft (3) is surrounded, and while having a rectangular cross-section configuration, four permanent magnets (5) magnetized in the direction of a path, (5), (5), and (5) are being fixed to the peripheral face of a shank (14a). Here, an adjacent permanent magnet (5) and (5) are mutually magnetized by hard flow.
[0004] And (the periphery section iron core (15) and (15) which have a sector cross-section configuration, 15), and (15) are fixed to the front face by the side of the stator (2) of a permanent magnet (5), (5), (5), and (5), and the arm section (14b) of a center-section iron core (14) is mutually connected with an adjacent periphery section iron core (15) and (15) with the connection iron core (16). Between the arm section (14b) of a center-section iron core (14), and a periphery section iron core (15), the opening (12) for decreasing the magnetic leakage flux which results from a periphery section iron core (15) to the arm section (14b) directly is formed. In addition, a periphery section iron core (15) and a connection iron core (16) carry out several multi-sheet laminating of the sheet metal-like piece of iron like a center-section iron core (14), and are formed.
[0005] In the above-mentioned permanent magnet motor, it energizes one by one by the control circuit which carries out an illustration abbreviation repeatedly to U phase winding (23) and V phase winding (24), V phase winding (24) and W phase winding (25), W phase winding (25), and U phase winding (23). By relation with the line of magnetic force which is generated from a permanent magnet (5) in the coil under energization, and penetrates a coil to it by this, the electromagnetic force based on the left-hand rule of Fleming will arise, and a rotator (10) will rotate according to this electromagnetic force.
[0006]
[Problem(s) to be Solved by the Invention] Drawing 6 expresses line-of-magnetic-force distribution in case the biggest running torque occurs with the rotator (10) at the time of the drive of the above-mentioned permanent magnet motor, and W phase winding (25) and U phase

winding (23) under the line-of-magnetic-force radial plane of a permanent magnet (5) and energization have countered mutually. In this condition, the greatest running torque acts on a rotator (10) according to the electromagnetic force generated in W phase winding (25) and U phase winding (23). However, in this permanent magnet motor, like illustration, the line of magnetic force generated from a permanent magnet (5) spread in the radial, had passed V phase winding (24) which does not contribute to rotation of a rotator (10), and this was lost and it had the problem from which high effectiveness is not acquired. The purpose of this invention is offering a permanent magnet motor more efficient than before.

[0007]

[Means for Solving the Problem] The permanent magnet motor concerning this invention holds a rotator (1) in the space formed in the center section of a stator (2) pivotable, and is constituted. To a stator (2) While the revolving shaft of a rotator (1) and the coil of two or more phases extended to parallel are arranged in two or more locations which surround a rotator (1), to a rotator (1) While two or more permanent magnets (5) magnetized in the direction of a path which intersects perpendicularly with a revolving shaft are arranged in two or more locations which surround a revolving shaft The front face by the side of the stator (2) of each permanent magnet (5) is made to contact, two or more periphery section iron cores (15) are arranged, and the coil of said two or more phases is made to rotate a rotator (1) by carrying out sequential energization. The low permeability section for converging the line of magnetic force generated between each permanent magnet (5) and a stator (2) in the center section of the periphery section iron core (15) on the field inserted into each permanent magnet (5) and a stator (2) is formed in each periphery section iron core (15).

[0008] Since it sets on the permanent magnet motor concerning this invention and line of magnetic force cannot pass along the low permeability section easily compared with other fields of a periphery section iron core (15), the line of magnetic force generated between each permanent magnet (5) and a stator (2) converges on the center section of the periphery section iron core (15). By this, most line of magnetic force generated from a permanent magnet (5) will penetrate the coil under energization, big electromagnetic force will occur in the coil under energization, and big running torque will occur in a rotator (1) according to this big electromagnetic force. Consequently, the rotation drive of the rotator (1) is carried out efficiently.

[0009] The low permeability section consists of a through tube (13) of the pair established by penetrating each periphery section iron core (15) to the shaft orientations of a rotator (1), and (13), and, specifically, the through tube (13) of this pair and (13) are arranged at both sides on both sides of the magnetic center line of the line of magnetic force generated between each permanent magnet (5) and a stator (2).

[0010] In this concrete configuration, the line of magnetic force with which air will constitute the low permeability section and the through tube (13) of a pair and (13) generate it between each permanent magnet (5) and a stator (2) since permeability is lower than an iron core will converge on the field across which it faced between the through tube (13) of a pair, and (13). According to this concrete configuration, the low permeability section can be formed by the simple configuration which prepared two through tubes (13) and (13) in the periphery section iron core (15).

[0011] Moreover, while the through tube (13) of said pair and (13) have the slit configuration where each is long and slender in the cross section which intersects perpendicularly with the revolving shaft of a rotator (1), specifically, mutual spacing is narrow toward the stator (2). According to this concrete configuration, the focusing effectiveness of line of magnetic force can be heightened further, and the rotation drive of the rotator (1) can be more efficiently carried out by this.

[0012]

[Effect of the Invention] In order to generate big running torque according to the permanent magnet motor concerning this invention, using effectively the line of magnetic force generated from a permanent magnet, drive effectiveness improves conventionally.

[0013]

[Embodiment of the Invention] Hereafter, along with a drawing, it explains concretely about the gestalt of operation of this invention. As the permanent magnet motor of this example is shown in drawing 1 and drawing 2 , the cylinder-like rotator (1) is held in the space formed in the center section of a cylinder-like stator (2) pivotable. The stator (2) of this example is completely the same as that of the former shown in drawing 5 , a rotator (1) is surrounded to the inner skin of a ring-like stator iron core (21), and 24 slots (22a) (22b) (22c) penetrated to the shaft orientations of a rotator (1) are cut in it at equal intervals. And U phase winding (23), V phase winding (24), and W phase winding (25) are twisted around these slots (22a) (22b) (22c), respectively.
[0014] On the other hand, the rotator (1) of this example is equipped with the connection iron core (16) which connects mutually one center-section iron core (14), four periphery section iron cores (15), (15), (15), (15), and both iron cores (14) and (15), (16), (16), and (16). These iron cores (14), (15), and (16) carry out several multi-sheet laminating of the sheet metal-like piece of iron (illustration abbreviation), and are formed. A cross-section configuration consists of a square shank (14a) and the four arm sections (14b) (14b) (14b) (14b) extended toward a stator (2) from four corners of this shank (14a), an output shaft (3) penetrates in the core of a shank (14a), and the center-section iron core (14) is being fixed to it. Moreover, an output shaft (3) is surrounded to the peripheral face of a shank (14a), and (four permanent magnets (5) and (5) which have a rectangular cross-section configuration, 5), and (5) are being fixed to it. The magnetization direction of the permanent magnet (5) which is magnetized in the direction of a path and adjoins each other, and (5) of each permanent magnet (5) is mutually reverse.
[0015] A periphery section iron core (15), (15), (15), and (15) have a sector cross-section configuration, and are being fixed to the front face by the side of the stator (2) of a permanent magnet (5), (5), (5), and (5). The adjacent arm section (14b) of a periphery section iron core (15), (15), and a center-section iron core (14) is mutually connected with a connection iron core (16), and the opening (12) for decreasing the magnetic leakage flux directly to [section / (14b) / arm] between the arm sections (14b) of each periphery section iron core (15) and a center-section iron core (14) from a periphery section iron core (15) is formed.
[0016] And the through tube (13) of the pair penetrated to the shaft orientations of a rotator (1) to the field inserted into each permanent magnet (5) and a stator (2) and (13) are established by the periphery section iron core (15), and the low permeability section for converging the line of magnetic force generated between each permanent magnet (5) and a stator (2) on the center section of the periphery section iron core (15) is constituted in it. The through tube (13) of a pair and (13) are established by both sides at the symmetry on both sides of the magnetic center line of the line of magnetic force generated between each permanent magnet (5) and a stator (2), and mutual spacing narrows toward a stator (2) and, as for the output shaft (3) of a rotator (1), they are presenting the shape of Ha's character in the cross section which intersects perpendicularly while each has a long and slender slit configuration. Since permeability is low compared with other fields of a periphery section iron core (15), line of magnetic force cannot pass along the through tube (13) of a pair, and (13) easily. Therefore, as shown in drawing 3 , most line of magnetic force generated from a permanent magnet (5) converges between the through tube (13) of a pair, and (13), and it passes a periphery section iron core (15), and it results in a coil (23), (24), and (25).
[0017] In the above-mentioned permanent magnet motor, it energizes one by one by the control circuit which carries out an illustration abbreviation repeatedly to U phase winding (23) and V phase winding (24), V phase winding (24) and W phase winding (25), W phase winding (25), and U phase winding (23). For example, in drawing 3 , in the condition that W phase winding (25) and U phase winding (23) are energizing, the line-of-magnetic-force distribution like illustration is formed, and the electromagnetic force based on the left-hand rule of Fleming arises in relation with the line of magnetic force which penetrates these coils (23) and (25) to W phase winding (25) and U phase winding (23). Here, since most line of magnetic force generated from a permanent magnet (5) penetrates W phase winding (25) and U phase winding (23) like illustration, electromagnetic force with line of magnetic force bigger as shown in drawing 6 than the former distributed and penetrated to U phase winding (23), V phase winding (24), and W phase winding (25) is acquired. According to this big electromagnetic force, big running torque occurs in a

rotator (1). Similarly, also in relation with W phase winding (25) and U phase winding (23) which (other three permanent magnets (5), (5), (5), these permanent magnets (5) and (5), and 5) counter, big electromagnetic force is acquired and big running torque occurs in a rotator (1). Such running torques are compounded and the rotation drive of the rotator (1) is carried out.
[0018] Next, when it changes from the energization to W phase winding (25) and U phase winding (23) to the energization to U phase winding (23) and V phase winding (24), each permanent magnet (5) will counter U phase winding (23) and V phase winding (24) under these energization at this time. By this, most line of magnetic force generated from a permanent magnet (5) penetrates U phase winding (23) and V phase winding (24) like the relation between above-mentioned W phase winding (25) and U phase winding (23), and big running torque occurs. Thus, by performing sequential energization to the coil of two adjacent phases, big running torque occurs continuously and rotation of a rotator (1) continues.
[0019] In the above-mentioned permanent magnet motor, drawing 4 is relation with distribution of the line of magnetic force generated from a permanent magnet, and expresses signs that big running torque is obtained. Distribution of the line of magnetic force which this drawing (a) generates from a permanent magnet in the range of 360 electrical angles, the wave of the current on which this drawing (b) flows the coil of a plane 1, the wave of the running torque which this drawing (c) generates in a rotator when a current flows to this coil, and this drawing (d) express the wave of the running torque of synthesis generated in a rotator, when a current flows to the coil of a three phase circuit.
[0020] Since the line of magnetic force generated from a permanent magnet (5) spreads in a radial in the conventional permanent magnet motor, as distribution of line of magnetic force is shown in this drawing (a) with a broken line, in order that the line of magnetic force which serves as distribution of the trapezoidal shape which spread on both sides from the energization section (120 electrical angles) shown in this drawing (b), and spreads on both sides of the energization section may penetrate the coil which is not energized, it did not produce running torque but had become magnetic leakage flux. On the other hand, in the permanent magnet motor of this invention, since the line of magnetic force generated from the permanent magnet like **** converges by the through tube of a pair, as distribution of line of magnetic force is shown in this drawing (a) as a continuous line, it becomes the distribution compressed at the energization section shown in this drawing (b), and the magnetic leakage flux which spreads on both sides of the energization section decreases more sharply than before. Consequently, the coil which the great portion of line of magnetic force generated from a permanent magnet is energizing will be penetrated, and as a continuous line shows to this drawing (c), bigger running torque than the conventional running torque shown with a broken line is obtained.
[0021] Since the running torque shown in this drawing (c) is generated about each of the coil of a three phase circuit and such running torques have the phase contrast of 60 electrical angles, the running torque of synthesis by which such running torques were totaled serves as flat distribution, as a continuous line shows to this drawing (d), and becomes larger than the running torque of the conventional synthesis shown with a broken line. Thus, in the permanent magnet motor of this invention, since the line of magnetic force generated from a permanent magnet (5) acts on a coil effectively and big running torque occurs in a rotator (1), drive effectiveness improves conventionally.
[0022] In addition, deformation various by technical within the limits given not only in the gestalt of the above-mentioned implementation but a claim is possible for each part configuration of this invention. For example, in the gestalt of the above-mentioned implementation, although this invention is carried out on the permanent magnet motor equipped with the coil (23) of a three phase circuit, (24), and (25), it can carry out not only on this but on the permanent magnet motor equipped with the coil of two phases or with a phases of four or more two or more phases. Moreover, in the gestalt of the above-mentioned implementation, although this invention is carried out on the permanent magnet motor equipped with four permanent magnets (5), (5), (5), and (5), it can carry out not only on this but on the permanent magnet motor equipped with two or more permanent magnets other than one piece or four piece.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is a sectional view showing the structure of the permanent magnet motor of this invention.
[Drawing 2] It is a perspective view showing structure same as the above.
[Drawing 3] In drawing 1 , it is drawing showing distribution of the line of magnetic force generated from a permanent magnet.
[Drawing 4] It is the wave form chart which compared with distribution of the line of magnetic force generated from a permanent magnet the running torque obtained by this by this invention and the former.
[Drawing 5] It is a sectional view showing the structure of the conventional permanent magnet motor.
[Drawing 6] In drawing 5 , it is drawing showing distribution of the line of magnetic force generated from a permanent magnet.
[Description of Notations]
(1) Rotator
(12) Opening
(13) Through tube
(14) Center-section iron core
(15) Periphery section iron core
(16) Connection iron core
(2) Stator
(21) Stator iron core
(22a) U phase slot
(22b) V phase slot
(22c) W phase slot
(23) U phase winding
(24) V phase winding
(25) W phase winding

[Translation done.]

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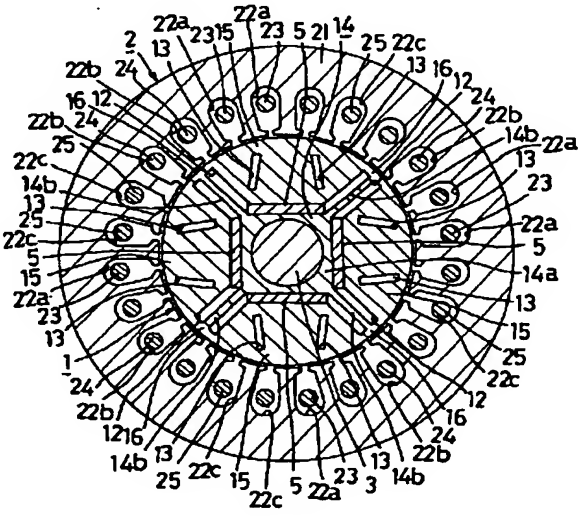
(54)【発明の名称】　永久磁石モータ

(57)【要約】
【課題】　固定子の中央部に形成された空間に、永久磁石を具えた回転子を回転可能に収容し、回転子を包囲して配設された複数相の巻線に順次通電することによって、回転子を回転させる永久磁石モータにおいて、従来よりも駆動効率を向上させる。
【解決手段】　本発明の永久磁石モータにおいては、各永久磁石５の固定子２側の表面に接触させて複数の外周部鉄芯15が配設され、各外周部鉄芯15には、各永久磁石５と固定子２に挟まれた領域に、各外周部鉄芯15を回転子１の軸方向に貫通する一対の貫通孔13、13が開設される。一対の貫通孔13、13は、各永久磁石５と固定子２の間に発生する磁力線の磁気的中心線を挟んで両側に対称に開設され、夫々が細長いスリット形状を有すると共に、固定子２に向かって互いの間隔が狭まってハの字状を呈している。



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【特許請求の範囲】

【請求項１】　回転子(１)には永久磁石(５)が配設されると共に永久磁石(５)の固定子(２)側に外周部鉄芯(15)が配設された永久磁石モータにおいて、外周部鉄芯(15)には、永久磁石(５)と固定子(２)の間に発生する磁力線を外周部鉄芯(15)の中央部に集束させるための低透磁率部が形成されている永久磁石モータ。

【請求項２】　固定子(２)の中央部に形成された空間に回転子(１)を回転可能に収容して構成され、固定子(２)には、回転子(１)を包囲する複数位置に、回転子(１)の回転軸と平行に伸びる複数相の巻線が配設される一方、回転子(１)には、回転軸を包囲する複数位置に、回転軸とは直交する径方向に着磁された複数の永久磁石(５)が配設されると共に、各永久磁石(５)の固定子(２)側の表面に接触させて複数の外周部鉄芯(15)が配設され、前記複数相の巻線に順次通電することによって、回転子(１)を回転させる永久磁石モータにおいて、各外周部鉄芯(15)には、各永久磁石(５)と固定子(２)に挟まれた領域に、各永久磁石(５)と固定子(２)の間に発生する磁力線を外周部鉄芯(15)の中央部に集束させるための低透磁率部が形成されている永久磁石モータ。

【請求項３】　低透磁率部は、各外周部鉄芯(15)を回転子(１)の軸方向に貫通して開設された一対の貫通孔(13)(13)から構成され、該一対の貫通孔(13)(13)は、各永久磁石(５)と固定子(２)の間に発生する磁力線の磁気的中心線を挟んで両側に配置されている請求項１又は請求項２に記載の永久磁石モータ。

【請求項４】　前記一対の貫通孔(13)(13)は、回転子(１)の回転軸とは直交する断面にて、夫々が細長いスリット形状を有すると共に、固定子(２)に向かって互いの間隔が狭まっている請求項３に記載の永久磁石モータ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、固定子の中央部に形成された空間に、永久磁石を具えた回転子を回転可能に収容し、回転子を包囲して配設された複数相の巻線に順次通電することによって、回転子を回転させる永久磁石モータに関するものである。

【０００２】

【従来の技術】図５は、従来の永久磁石モータの構造を表わしており、円筒状の固定子(２)の中央部に形成された空間に、円柱状の回転子(10)が回転可能に収容されている。固定子(２)は、リング状の固定子鉄芯(21)を具え、該固定子鉄芯(21)の内周面には、回転子(10)を包囲して、回転子(10)の軸方向に貫通する２４個のスロット(22a)(22b)(22c)が等間隔に凹設されている。具体的には、Ｕ相スロット(22a)、Ｖ相スロット(22b)及びW相スロット(22c)が、反時計回りに２つずつ繰り返し凹設されている。そして、Ｕ相スロット(22a)、Ｖ相スロット(22b)及びW相スロット(22c)に夫々、Ｕ相巻線(23)、Ｖ相巻線(24)及びW相巻線(25)が巻き付けられている。

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【０００３】一方、回転子(10)は、断面形状が正方形の軸部(14a)と、該軸部(14a)の４つの角部から固定子(２)に向かって伸びる４本のアーム部(14b)(14b)(14b)(14b)とからなる中央部鉄芯(14)を有している。尚、中央部鉄芯(14)は、薄板状の鉄片を多数枚積層して形成される。中央部鉄芯(14)の軸部(14a)の中心部には、出力軸(３)が貫通して固定されている。又、軸部(14a)の外周面には、出力軸(３)を包囲して、長方形の断面形状を有すると共に径方向に着磁された４つの永久磁石(５)(５)(５)(５)が固定されている。ここで、隣り合う永久磁石(５)(５)は、互いに逆方向に着磁されている。

【０００４】そして永久磁石(５)(５)(５)(５)の固定子(２)側の表面に、扇形の断面形状を有する外周部鉄芯(15)(15)(15)(15)が固定され、隣り合う外周部鉄芯(15)(15)と中央部鉄芯(14)のアーム部(14b)は、連結鉄芯(16)によって互いに連結されている。中央部鉄芯(14)のアーム部(14b)と外周部鉄芯(15)との間には、外周部鉄芯(15)から直接にアーム部(14b)へ至る漏洩磁束を減少させるための空隙(12)が形成されている。尚、外周部鉄芯(15)及び連結鉄芯(16)は、中央部鉄芯(14)と同様に、薄板状の鉄片を多数枚積層して形成される。

【０００５】上記永久磁石モータにおいては、図示省略する制御回路によって、Ｕ相巻線(23)及びＶ相巻線(24)、Ｖ相巻線(24)及びW相巻線(25)、W相巻線(25)及びＵ相巻線(23)に順次、繰り返し通電する。これによって、通電中の巻線に、永久磁石(５)から発生して巻線を貫通する磁力線との関係で、フレミングの左手の法則に基づく電磁力が生じ、該電磁力により回転子(10)が回転することになる。

【０００６】

【発明が解決しようとする課題】図６は、上記永久磁石モータの駆動時において、回転子(10)に最も大きな回転トルクが発生するときの磁力線分布を表わしており、永久磁石(５)の磁力線放射面と通電中のW相巻線(25)及びＵ相巻線(23)とが互いに対向している。この状態では、W相巻線(25)及びＵ相巻線(23)に発生する電磁力によって、回転子(10)に最大の回転トルクが作用する。しかしながら、該永久磁石モータにおいては、永久磁石(５)から発生した磁力線は、図示の如く放射状に拡がって、回転子(10)の回転に寄与しないＶ相巻線(24)をも通過しており、これが損失となって高い効率が得られない問題があった。本発明の目的は、従来よりも高効率の永久磁石モータを提供することである。

【０００７】

【課題を解決する為の手段】本発明に係る永久磁石モータは、固定子(２)の中央部に形成された空間に回転子(１)を回転可能に収容して構成され、固定子(２)には、回転子(１)を包囲する複数位置に、回転子(１)の回転軸と平行に伸びる複数相の巻線が配設される一方、回転子

(１)には、回転軸を包囲する複数位置に、回転軸とは直交する径方向に着磁された複数の永久磁石(５)が配設されると共に、各永久磁石(５)の固定子(２)側の表面に接触させて複数の外周部鉄芯(15)が配設され、前記複数相の巻線に順次通電することによって、回転子(１)を回転させるものである。各外周部鉄芯(15)には、各永久磁石(５)と固定子(２)に挟まれた領域に、各永久磁石(５)と固定子(２)の間に発生する磁力線を外周部鉄芯(15)の中央部に集束させるための低透磁率部が形成されている。

【０００８】本発明に係る永久磁石モータにおいては、低透磁率部は外周部鉄芯(15)の他の領域に比べて磁力線が通り難いため、各永久磁石(５)と固定子(２)の間に発生する磁力線は、外周部鉄芯(15)の中央部に集束する。これによって、永久磁石(５)から発生した磁力線の殆どが、通電中の巻線を貫通することとなって、通電中の巻線に大きな電磁力が発生し、この大きな電磁力によって、回転子(１)に大きな回転トルクが発生することになる。この結果、回転子(１)が効率的に回転駆動される。

【０００９】具体的には、低透磁率部は、各外周部鉄芯(15)を回転子(１)の軸方向に貫通して開設された一対の貫通孔(13)(13)から構成され、該一対の貫通孔(13)(13)は、各永久磁石(５)と固定子(２)の間に発生する磁力線の磁気的中心線を挟んで両側に配置されている。

【００１０】該具体的構成においては、空気は鉄芯よりも透磁率が低いため、一対の貫通孔(13)(13)が低透磁率部を構成することとなって、各永久磁石(５)と固定子(２)の間に発生する磁力線は、一対の貫通孔(13)(13)の間に挟まれた領域に集束することになる。該具体的構成によれば、外周部鉄芯(15)に２つの貫通孔(13)(13)を設けた簡易な構成によって、低透磁率部を形成することが出来る。

【００１１】又、具体的には、前記一対の貫通孔(13)(13)は、回転子(１)の回転軸とは直交する断面にて、夫々が細長いスリット形状を有すると共に、固定子(２)に向かって互いの間隔が狭まっている。該具体的構成によれば、磁力線の集束効果を更に高めることが出来、これによって回転子(１)をより効率的に回転駆動することが出来る。

【００１２】

【発明の効果】本発明に係る永久磁石モータによれば、永久磁石から発生する磁力線を有効に利用して大きな回転トルクを発生させるため、駆動効率が従来よりも向上する。

【００１３】

【発明の実施の形態】以下、本発明の実施の形態につき、図面に沿って具体的に説明する。本実施例の永久磁石モータは、図１及び図２に示す如く、円筒状の固定子(２)の中央部に形成された空間に、円柱状の回転子(１)が回転可能に収容されている。　本実施例の固定子(２)は、図５に示す従来と全く同一であって、リング状の固

定子鉄芯(21)の内周面に、回転子(１)を包囲して、回転子(１)の軸方向に貫通する２４個のスロット(22a)(22b)(22c)が等間隔に凹設されている。そして、これらのスロット(22a)(22b)(22c)に夫々、Ｕ相巻線(23)、Ｖ相巻線(24)及びW相巻線(25)が巻き付けられている。

【００１４】一方、本実施例の回転子(１)は、１つの中央部鉄芯(14)、４つの外周部鉄芯(15)(15)(15)(15)及び両鉄芯(14)(15)を互いに連結する連結鉄芯(16)(16)(16)(16)を具え、これらの鉄芯(14)(15)(16)は、薄板状の鉄片(図示省略)を多数枚積層して形成されている。中央部鉄芯(14)は、断面形状が正方形の軸部(14a)と、該軸部(14a)の４つの角部から固定子(２)に向かって伸びる４本のアーム部(14b)(14b)(14b)(14b)とから構成され、軸部(14a)の中心部には、出力軸(３)が貫通して固定されている。又、軸部(14a)の外周面には、出力軸(３)を包囲して、長方形の断面形状を有する４つの永久磁石(５)(５)(５)(５)が固定されている。各永久磁石(５)は、径方向に着磁され、隣り合う永久磁石(５)(５)の着磁方向は、互いに逆となっている。

【００１５】外周部鉄芯(15)(15)(15)(15)は、扇形の断面形状を有し、永久磁石(５)(５)(５)(５)の固定子(２)側の表面に固定されている。隣り合う外周部鉄芯(15)(15)と中央部鉄芯(14)のアーム部(14b)は、連結鉄芯(16)によって互いに連結され、各外周部鉄芯(15)と中央部鉄芯(14)のアーム部(14b)との間には、外周部鉄芯(15)から直接にアーム部(14b)へ至る漏洩磁束を減少させるための空隙(12)が形成されている。

【００１６】そして外周部鉄芯(15)には、各永久磁石(５)と固定子(２)に挟まれた領域に、回転子(１)の軸方向に貫通する一対の貫通孔(13)(13)が開設され、各永久磁石(５)と固定子(２)の間に発生する磁力線を外周部鉄芯(15)の中央部に集束させるための低透磁率部を構成している。一対の貫通孔(13)(13)は、各永久磁石(５)と固定子(２)の間に発生する磁力線の磁気的中心線を挟んで両側に対称に開設され、回転子(１)の出力軸(３)とは直交する断面にて、夫々が細長いスリット形状を有すると共に、固定子(２)に向かって互いの間隔が狭まってハの字状を呈している。一対の貫通孔(13)(13)は、外周部鉄芯(15)の他の領域に比べて透磁率が低いため、磁力線が通り難い。従って、永久磁石(５)から発生した磁力線の殆どが、図３に示す如く一対の貫通孔(13)(13)の間に集束して外周部鉄芯(15)を通過し、巻線(23)(24)(25)に至る。

【００１７】上記永久磁石モータにおいては、図示省略する制御回路により、Ｕ相巻線(23)及びＶ相巻線(24)、Ｖ相巻線(24)及びW相巻線(25)、W相巻線(25)及びＵ相巻線(23)に順次、繰り返し通電する。例えば図３において、W相巻線(25)及びＵ相巻線(23)が通電されている状態では、図示の如き磁力線分布が形成され、W相巻線(25)及びＵ相巻線(23)に、これらの巻線(23)(25)を貫通す

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る磁力線との関係でフレミングの左手の法則に基づく電磁力が生じる。ここで、永久磁石(５)から発生した磁力線の殆どが、図示の如くW相巻線(25)及びU相巻線(23)を貫通するので、図６に示す如く磁力線がU相巻線(23)、V相巻線(24)及びW相巻線(25)に分散して貫通していた従来よりも大きな電磁力が得られる。この大きな電磁力によって、回転子(１)に大きな回転トルクが発生する。同様に、他の３つの永久磁石(５)(５)(５)と、これらの永久磁石(５)(５)(５)が対向するW相巻線(25)及びU相巻線(23)との関係においても、大きな電磁力が得られ、回転子(１)に大きな回転トルクが発生する。これらの回転トルクが合成されて、回転子(１)が回転駆動される。

【００１８】次に、W相巻線(25)及びU相巻線(23)に対する通電からU相巻線(23)及びV相巻線(24)に対する通電に切り替わると、この時点で各永久磁石(５)は、これら通電中のU相巻線(23)及びV相巻線(24)に対向することになる。これによって、上述のW相巻線(25)及びU相巻線(23)との関係と同様に、永久磁石(５)から発生した磁力線の殆どが、U相巻線(23)及びV相巻線(24)を貫通して、大きな回転トルクが発生する。この様にして、隣り合う２相の巻線に順次通電を行なうことによって、大きな回転トルクが連続的に発生し、回転子(１)の回転が持続するのである。

【００１９】図４は、上記永久磁石モータにおいて、永久磁石から発生する磁力線の分布との関係で、大きな回転トルクが得られる様子を表わしている。同図(ａ)は、電気角３６０度の範囲において永久磁石から発生する磁力線の分布、同図(ｂ)は１相の巻線を流れる電流の波形、同図(ｃ)は該巻線に電流が流れることによって回転子に発生する回転トルクの波形、同図(ｄ)は３相の巻線に電流が流れることによって回転子に発生する総合の回転トルクの波形を表わしている。

【００２０】従来の永久磁石モータにおいては、永久磁石(５)から発生した磁力線は放射状に拡がるため、磁力線の分布は、同図(ａ)に破線で示す如く、同図(ｂ)に示す通電区間(電気角１２０度)よりも両側に拡がった台形状の分布となっており、通電区間の両側に拡がる磁力線は、通電されていない巻線を貫通するため、回転トルクを生じず、漏洩磁束となっていた。これに対し、本発明の永久磁石モータにおいては、上述の如く、永久磁石から発生した磁力線が一対の貫通孔によって集束されるため、磁力線の分布は、同図(ａ)に実線で示す如く、同図(ｂ)に示す通電区間に圧縮された分布となり、通電区間の両側に拡がる漏洩磁束は従来よりも大幅に減少する。この結果、永久磁石から発生する磁力線の大部分が通電中の巻線を貫通することとなって、同図(ｃ)に実線で示す如く、破線で示す従来の回転トルクよりも大きな回転トルクが得られる。

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【００２１】同図(ｃ)に示す回転トルクは、３相の巻線の夫々について発生し、これらの回転トルクは電気角６０度の位相差を有するため、これらの回転トルクが合計された総合の回転トルクは、同図(ｄ)に実線で示す如く平坦な分布となり、破線で示す従来の総合の回転トルクよりも大きくなる。この様に、本発明の永久磁石モータにおいては、永久磁石(５)から発生した磁力線が有効に巻線に作用して、回転子(１)に大きな回転トルクが発生するので、従来よりも駆動効率が向上する。

【００２２】尚、本発明の各部構成は上記実施の形態に限らず、特許請求の範囲に記載の技術的範囲内で種々の変形が可能である。例えば、上記実施の形態においては、本発明を３相の巻線(23)(24)(25)を具えた永久磁石モータに実施しているが、これに限らず、２相或いは４相以上の複数相の巻線を具えた永久磁石モータにも実施可能である。又、上記実施の形態においては、本発明を４個の永久磁石(５)(５)(５)(５)を具えた永久磁石モータに実施しているが、これに限らず、１個或いは４個以外の複数個の永久磁石を具えた永久磁石モータにも実施可能である。

【図面の簡単な説明】

【図１】本発明の永久磁石モータの構造を表わす断面図である。

【図２】同上の構造を表わす斜視図である。

【図３】図１において、永久磁石から発生する磁力線の分布を表わす図である。

【図４】永久磁石から発生する磁力線の分布と、これによって得られる回転トルクを、本発明と従来で比較した波形図である。

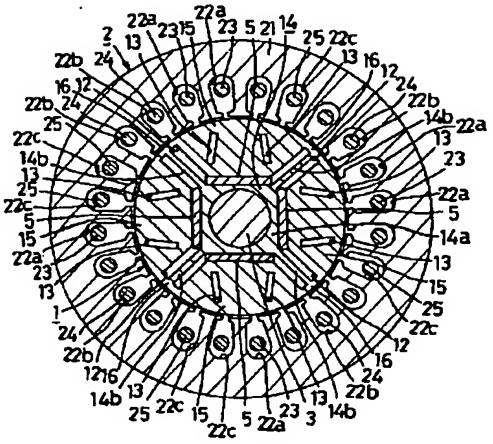
【図５】従来の永久磁石モータの構造を表わす断面図である。

【図６】図５において、永久磁石から発生する磁力線の分布を表わす図である。

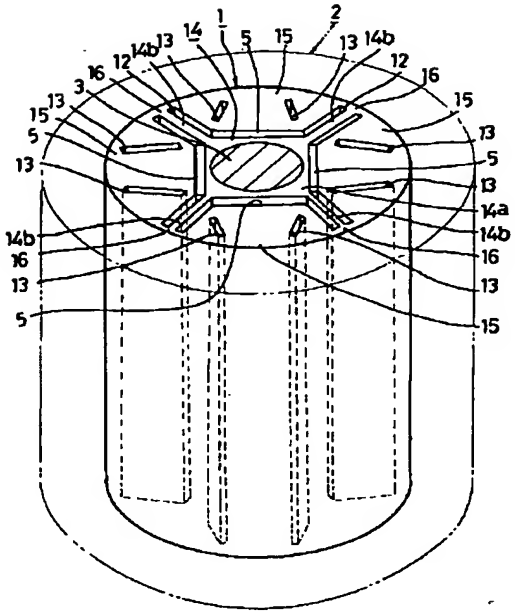
【符号の説明】

(１) 回転子
(12) 空隙
(13) 貫通孔
(14) 中央部鉄芯
(15) 外周部鉄芯
(16) 連結鉄芯
(２) 固定子
(21) 固定子鉄芯
(22a) U相スロット
(22b) V相スロット
(22c) W相スロット
(23) U相巻線
(24) V相巻線
(25) W相巻線

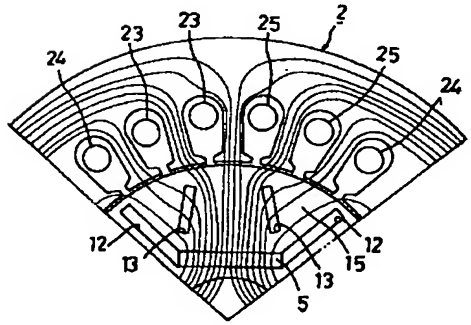
【図１】



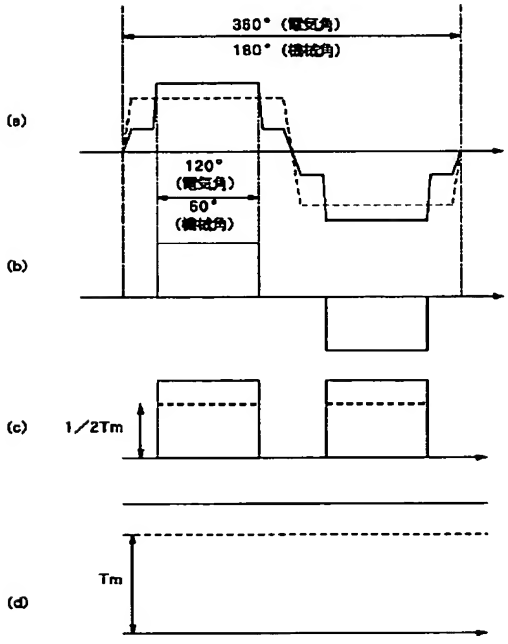
【図２】



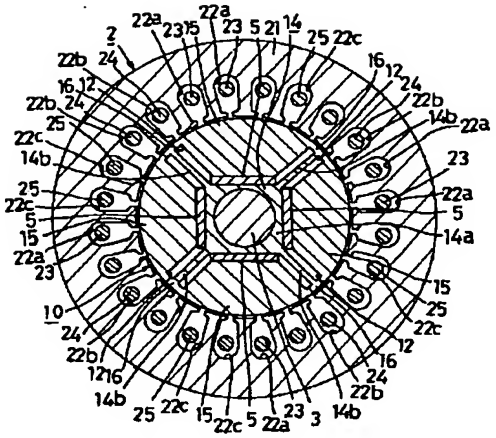
【図３】



【図４】



【図５】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24
22b
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22b
14b
22a
22b
16
12
24
25
22c
14b
23
25
22c
22a
5
5
14a
15
23
15
25
10
22c
24
12
22b
16
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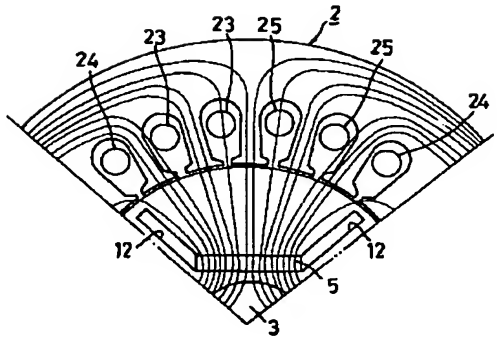
22c
5
22a
23
3
14b

【図６】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